Swarm Unmanned Aerial Vehicles using Emergence (SUAVE)

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Introduction

- SUAVE uses a swarm of SUASs to more efficiently create a three-dimensional map of any given space, specifically in GPS-denied environments, using an onboard computer, camera, and Lidar through Simultaneous Localization and Mapping (SLAM).
- SUAVE has a wide scope of applications such as surveying and mapping in treacherous locations or delicate environments.
- SUAVE will be controlled by assigning a virtual spring between each drone and representing the translation and rotation of each drone's frame with dual quaternions while also having a virtual frame assigned in the center of mass of the swarm acting as a reference.

Objectives

- The construction of a small drone swarm in the number of 7 drones.
- Ironing out the control equation and governing the motion between the drones using a virtual spring and damper between each of the drones.
- Development of a SLAM map that uses all of the drones to create a map that is larger and more detailed than one from a single drone.
- Build a ROS image to test and apply SLAM programs and control systems.
- Development of a digital twin for the whole swarm.

Methods

- Begin using smaller drones (DJI Tellos) to map, track motion, and control the distance between them.
- Construct and apply custom drone platforms with depth-sensing cameras to develop the SLAM algorithm further for a swarm to map any given location. This swarm will also have the motion of the entire system charted using one dual quaternion.
- Generate the control system using a digital twin of the swarm and fine tuning the controls with dual quaternions applied to each drone's frame with reference to the swarm's base frame.

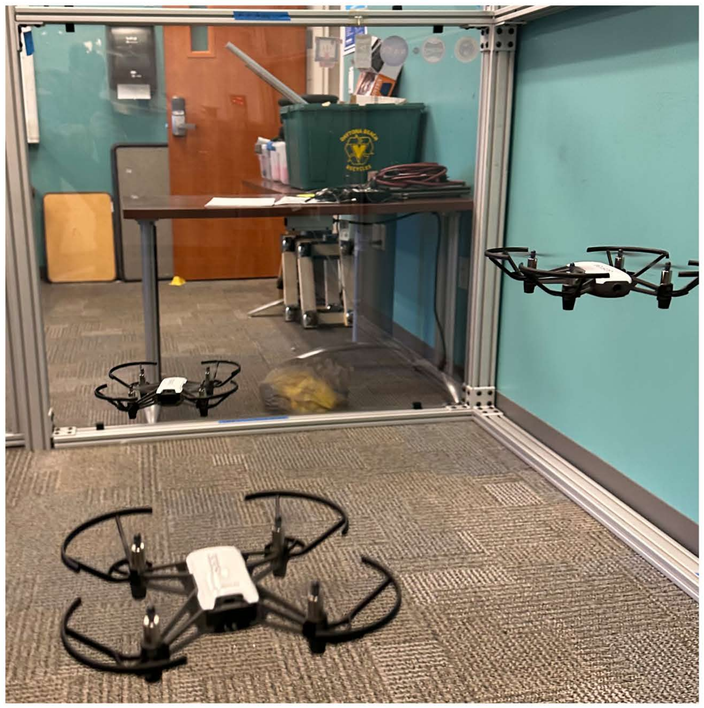

Figure 1: Swarm of DJI Tellos

Progress

- Control of multiple Tellos through an external single-board computer with a connection between the drones and Wi-Fi modules.
- The construction of a larger drone platform consisting of improved equipment.
- The generation of our first 3D maps outside of the slam algorithm.
- The development of a ROS image containing the tools we need for drone swarm control.

Figure 2: Small Unmanned Aerial System (SUAS)

Conclusion & Future Work

- The SUAVE system will be a versatile tool in topographical mapping but will require further development at this time to reach this goal. We can currently show our control and communication with our off-the-shelf drones. The control system we are currently developing should prove extremely advantageous for swarm technology if proven first on our platform.